

BRITISH STANDARD 3250 : Part 2 : 1961

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Thermal Testing of Domestic Solid Fuel Burning Appliances with Convection

Part 2. Hood Method

BRITISH STANDARDS INSTITUTION

METHOD FOR THE
THERMAL TESTING OF DOMESTIC
SOLID FUEL BURNING
APPLIANCES WITH CONVECTION

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BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

BRITISH STANDARDS HOUSE, 2 PARK ST., LONDON, W.1

TELEGRAMS: STANDARDS, AUDLEY, LONDON

TELEPHONE: MAYFAIR 9000

B.S. 3250 : Part 2 : 1961

THIS BRITISH STANDARD, having been approved by the Solid Fuel Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 14th April, 1961.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

A complete list of British Standards, numbering over 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 15s.

This standard makes reference to the following British Standards and Code of Practice:

- B.S. 89. Electrical indicating instruments.
- B.S. 90. Graphic (recording or chart-recording) ammeters, voltmeters, wattmeters, frequency meters and power-factor meters.
- B.S. 410. Test sieves.
- B.S. 758. Small domestic hot-water supply boilers using solid fuel.
- B.S. 1016. Methods for the analysis and testing of coal and coke.
- B.S. 1017. The sampling of coal and coke.
Part 2. Sampling of coke.
- B.S. 1042. Code for flow measurement.
- B.S. 1251. Open fireplace components.
Part 1. Firebacks for use with inset open fires.
Part 2. Fireplace surrounds and hearths.
- B.S. 1387. Steel tubes and tubulars suitable for screwing to B.S. 21 pipe threads.
- B.S. 1827. Reference tables for thermocouples.
- B.S. 2845. Coke burning inset open fires without boiler and without convection.
Part 2. Performance and constructional requirements.
- CP 403. Open fires, heating stoves and cookers burning solid fuel.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:
Committee reference SFE/13 and SFE/13/-/1
Draft for comment A(SFE) 492

CONTENTS

Co-operating organizations	Page 4
Foreword	5

METHOD OF TEST

SECTION ONE : GENERAL

1. Scope	6
2. Definitions	6

SECTION TWO : APPARATUS REQUIRED

3. Collection hood	7
4. Temperature measurement section	7
5. Recess	7
6. Radiation screens	8
7. Flow measuring device	8
8. Fan	8
9. Radiometer	9
10. Electrical instruments	9
11. Pressure measurement	9

SECTION THREE : INSTALLATION OF APPLIANCES
AND APPARATUS FOR TEST

12. Test chimney	9
13. Installation in a standard fireplace opening	10
14. Installation in a builder's opening	11
15. Installation of freestanding appliances	11
16. Installation of appliances with boilers	12

SECTION FOUR : TEST PROCEDURE

17. Test fuel	13
18. Appliances in a standard fireplace opening	14
19. Appliances in a builder's opening	16
20. Freestanding openable stoves	17
21. Freestanding closed stoves	18
22. Boiler output	18

SECTION FIVE : CALCULATIONS

23. Convection output	18
24. Radiation output	19
25. Boiler output	20

APPENDIX

Instructions for the use of the B.C.U.R.A. radiometer for radiation measurement in appliance testing	21
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B.S. 3250 : Part 2 : 1961

CO-OPERATING ORGANIZATIONS

The Solid Fuel Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Association of Boiler Setters, Chimney and Furnace Constructors
 Association of British Chemical Manufacturers
 Association of Consulting Engineers (Incorporated)
 Association of Heating, Ventilating and Domestic Engineering Employers
 British Cast Iron Research Association
 British Chemical Plant Manufacturers' Association
 *British Coal Utilisation Research Association
 *British Coke Research Association
 *British Coking Industry Association
 British Electrical and Allied Manufacturers' Association
 British Engineers' Association
 British Iron and Steel Federation
 *British Ironfounders' Association
 Chamber of Coal Traders
 *Coal Utilisation Council
 Coke Oven Managers' Association
 Combustion Engineering Association
 Council of Ironfoundry Associations
 Electricity Council, the Generating Board and Area Boards in England and Wales
 Federation of British Industries
 *Gas Council
 Imperial Chemical Industries Limited
 Institute of British Foundrymen
 Institute of Fuel
 Institution of Chemical Engineers
 Institution of Gas Engineers
 *Institution of Heating and Ventilating Engineers
 Institution of Mechanical Engineers
 Iron and Steel Institute
 Low Temperature Coal Distillers' Association of Gt. Britain Ltd.
 *Ministry of Housing and Local Government
 *Ministry of Power
 Ministry of Works
 *National Coal Board
 Society of British Gas Industries
 Society of Chemical Industry
 Water-tube Boilermakers' Association
 *Women's Advisory Council on Solid Fuel

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Ceramic Tile Council
 Copper Cylinder and Boiler Manufacturers
 D.S.I.R.—Building Research Station
 Fireclay Grate Back Association
 Good Housekeeping Institute
 Institution of Municipal Engineers
 Ironfounders' National Confederation
 National Fireplace Makers' Association
 Range Boiler Makers' Association Ltd.
 Royal Institute of British Architects
 Society of Housing Managers
 Solid Smokeless Fuels Federation
 Vitreous Enamellers' Association

BRITISH STANDARD METHOD FOR THE THERMAL TESTING OF DOMESTIC SOLID FUEL BURNING APPLIANCES WITH CONVECTION

Part 2. Hood Method

FOREWORD

Of recent years increasing attention has been given to the further development of domestic solid fuel space heating appliances incorporating convection, since such appliances can give higher thermal efficiencies and a more comfortable form of heating. The measurement of convection from a solid fuel appliance is complicated by the widely varying shapes of the appliances themselves and particularly of the warm air outlets. Furthermore, the earlier measuring devices all tended to alter the natural movement of the warm air.

Two methods of measurement are given in this standard and the choice of method will largely depend on laboratory facilities. Part 1 deals with the Flue Loss Method, in which the total heat output is obtained by determining the percentage heat content of the flue gases and the ashpit loss and deducting the sum from 100 per cent. The radiation output and, in the case of appliances with boiler, the boiler output are determined separately and the convection output is obtained by difference. This method is applicable to freestanding appliances with coke as the test fuel. It is also suitable for other appliances with convection taken from the sides and back of the unit installed in a builder's opening or in front of an existing fireback, if allowance is made for the heat losses through the setting. Part 2 deals with the Hood Method, in which the convection warm air is collected in and flows through a hood where its heat content is measured directly. This method is applicable to all types of convector appliances burning solid fuel, coke being selected as the test fuel for the purposes of the present standard.

The thermal output measured by either method should normally correspond fairly closely to that which the appliance will give under domestic conditions, but no arbitrary set of tests can cover the wide range of comfort standards, which depend upon individual habits and economy of operation. The various efficiency figures given by the test method used for the different types of appliance cannot, therefore, be directly interpreted in terms of domestic fuel economy.

NOTE. Where metric equivalents are stated the figures in British units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on the tables in B.S. 350, 'Conversion factors and tables'.

METHOD OF TEST

SECTION ONE : GENERAL

SCOPE

1. This standard describes a test method by which may be determined the thermal efficiency of the majority of solid fuel fired domestic space heating appliances which incorporate as a design feature the production of convected heat.

The method is based essentially upon the direct measurement of the radiant and convected heat from the appliance, the former being measured by a radio-meter and the latter being collected in an aspirated hood and passed to apparatus which enables the volume and temperature rise of the warmed air to be determined.

DEFINITIONS

2. For the purposes of this British Standard the following definitions apply:

a. Charging to the datum. A stove is charged to the datum when the maximum amount of fuel is charged, provided no pieces of fuel fall out when the charging door is opened and provided the flue outlet is not blocked by fuel in any way.

An open fire is charged to the datum in the following manner: The fire is filled with the test coke by shovelling from a heap on the floor or on a tray. No artificial packing of the coke, such as beating down, shall be carried out, but final shaping of the surface of the fuel bed by hand placing is allowed. The fire is considered to be full when the surface of the fuel slopes upwards from the inner edge of the topmost part of the firefront or front bars at an angle of 35° to the horizontal or to the bottom edge of any flue restrictor plate or of the flue opening, whichever is the lower.

b. Combustion rate. The weight in pounds of test coke burned per hour.

c. Fuel capacity. The fuel capacity of the appliance is that volume in cubic feet occupied by the test coke when the appliance is charged to the datum.

d. De-ashing. Clearance of ash from the firebars as far as is practicable. If the appliance has a mechanical de-ashing device, this shall be used exclusively. Otherwise a thin bladed poker shall be used and the fuel shall be loosened by inserting the poker from above. The operation of de-ashing and refuelling should not take longer than two minutes.

SECTION TWO : APPARATUS REQUIRED

The paragraphs below define the function and, where appropriate, the construction of the apparatus required*.

COLLECTION HOOD

3. A collection hood of the dimensions shown in Fig. 1 shall be provided. The hood shall be made from bright aluminium sheet of good commercial quality, not less than 20 S.W.G. (0.035 in, 0.91 mm) in thickness. Care shall be taken during manufacture not to impair the surface finish. Subsequent to manufacture, the outer and inner surfaces shall be maintained in a bright condition by the use of metal polish of a grade suitable for chromium plate.

The space between the inner and outer skins of the hood shall be packed evenly with glass wool, such that the weight of material used is approximately 6 lb (2.7 kg).

All metal to metal seams on the hood shall be coated with a resilient jointing compound so as to remain substantially airtight.

An extension piece shall also be provided in accordance with Fig. 1. This shall be constructed from the same materials and in the same manner as the collecting hood, and shall be maintained in the same condition.

TEMPERATURE MEASUREMENT SECTION

4. A temperature measurement section in accordance with Fig. 1 shall be provided. It shall be constructed from the same materials in the same manner and maintained in the same condition as the collecting hood. The thermocouples shall be of any suitable material for measuring temperatures in the range 50—200°F (10—95°C), but shall be not thicker than 26 S.W.G. (0.018 in, 0.46 mm). The use of copper-constantan is recommended, as the electrical resistance of such couples is relatively low. The thermocouples shall be wired in series and the four hot junctions inserted in the ducting in the position shown. At least 6 ft (2 m) of wire should be provided between the hot and cold junctions.

RECESS

5. A screened open-fronted enclosure (hereinafter referred to as the 'recess') in accordance with Figs. 2, 3 and 4 shall be provided. The material used for the construction of the walls of the recess shall be bright aluminium sheet of good commercial quality and during manufacture of the recess care shall be taken not to destroy the bright finish of the sheet.

* Engineering drawings for the construction of this equipment may be obtained on application to the Director, British Standards Institution, 2 Park Street, London, W.1.

B.S. 3250 : Part 2 : 1961

The innermost walls of the recess shall be painted with a photographic matt black paint on both faces, with the exception of vertical strips 6 in (15 cm) wide at the front on both faces of the side walls.

The unpainted surfaces shall be kept bright in the manner described in Clause 3 and the matt black paint shall be maintained in good condition. It is strongly recommended that, when the painted surface requires renewal, the whole of the old coat should be stripped off before repainting. If this is not done, difficulty may be encountered in achieving a matt surface.

All joints and seams in the apparatus, with the exception of those listed below, shall be sealed with jointing compound so that no substantial leakage between the air spaces, or to and from the inside of the recess, can occur.

The joints on the flanges of the removable top and back centre sections shall be sealed with a soft asbestos gasket or other suitable material.

When the wider of these two sets of sections is used, the top front outer sections of the recess shall be closed in the manner indicated in Fig. 5. The components effecting the sealing will be subsequently referred to as 'hood side wings'.

RADIATION SCREENS

6. Radiation screens for cold junctions shall be provided, consisting of open-ended cylinders of internal diameter 1.5 in (40 mm) and length 6 in (15 cm) constructed from polished aluminium sheet or, alternatively, from mild steel covered on both sides with aluminium foil.

FLOW MEASURING DEVICE

7. A flow measuring device suitable for use with air flows in the range of 5000—20 000 ft³/h (140—560 m³/h) and with an accuracy of ± 3 per cent shall be provided. Any of the methods described in B.S. 1042, 'Code for flow measurement', may be used. Alternatively a B.C.U.R.A. recording vane anemometer may be employed if it is desired to record air flow. If the latter instrument is used it shall be calibrated in the ducting in which it will be used by any of the methods described in B.S. 1042. It is strongly recommended, however, that the instrument mounted in its ducting should be calibrated by the National Physical Laboratory.

Means for measuring the temperature of air flowing through the flowmeter shall be provided.

FAN

8. A fan capable of extracting up to 20 000 ft³/h (560 m³/h) through the assembled apparatus as described in Section Three shall be provided. Attention is drawn to the fact that the rating of the fan will, to some extent, depend upon the type of meter employed to measure air flow.

RADIOMETER

9. A B.C.U.R.A. cage radiometer shall be provided. The instrument shall be supplied by the British Coal Utilisation Research Association and the calibration factor used shall be that supplied by the Association. In addition the conditions and recommendations listed in the Appendix shall be observed.

ELECTRICAL INSTRUMENTS

10. Instruments for measuring electrical outputs* within the range 0—30 mV with an accuracy of ± 2 per cent shall be provided. These should preferably be potentiometers of either the manually or automatically operated type. If a millivolt meter is used, the indicated output shall be corrected to take account of the input resistance with which it is being used.

PRESSURE MEASUREMENT

11. The following instruments are required:

- a. A barometer for measuring atmospheric pressure to an accuracy of ± 10 millibars.
- b. A manometer capable of measuring pressure differences in the range 0—10 inH₂O (0—20 mmHg) with an accuracy of ± 0.1 inH₂O (0.2 mmHg).

SECTION THREE: INSTALLATION OF APPLIANCES AND APPARATUS FOR TEST

TEST CHIMNEY

12. The appliance shall be installed for test in or connected to a chimney setting conforming to that specified in B.S. 758 or B.S. 2845, Part 2†.

The chimney shall terminate inside the test room and shall be provided with a hood vented either naturally or by mechanical means. In the latter case the suction effect of the extraction fan on the chimney draught, measured approximately 5 ft (1.5 m) above the hearth level when the flue is cold, shall be less than 0.004 inH₂O (0.008 mmHg).

For freestanding stoves or similar appliances, a concrete hearth 3 in (75 mm) thick and large enough to fit the base of the appliance to be tested, but not less than 21 in (53 cm) square, is required, mounted on a stand so that the top of the hearth is 3 ft (1 m) above ground level. The materials used in making this stand are not critical, but the use of one of the proprietary pre-slotted steel angles is recommended.

* See B.S. 89, 'Electrical indicating instruments'.

B.S. 90, 'Graphic (recording or chart-recording) ammeters, voltmeters, wattmeters, frequency meters and power-factor meters'.

† B.S. 758, 'Small domestic hot-water supply boilers using solid fuel'.

B.S. 2845, 'Coke burning inset open fires'. Part 2, 'Performance and constructional requirements'.